

## CLAIMS

What is claimed is:

1. An apparatus for detecting and responding to a surge event in a locomotive engine system including a turbocharger and a diesel engine, the apparatus comprising:  
a sensor detecting an operating parameter of the turbocharger or the engine and generating a sensor signal indicative of the detected operating parameter; and  
an engine control system responsive to the sensor signal for controlling a plurality of operational controls of the diesel engine system, wherein the engine control system modifies one or more operational controls of the diesel engine system when the sensor signal indicates a surge event.
2. The apparatus of claim 1, wherein the engine control system controls a speed of the diesel engine and wherein the modified operational control is the speed of the diesel engine.
3. The apparatus of claim 1, wherein the engine control system controls the fuel injection advance angle and wherein the modified operational control is the advance angle of the fuel injection system.
4. The apparatus of claim 1, wherein the engine control system controls a horsepower rating of an electrical transmission system and wherein the modified operational control is load on the engine system.
5. The apparatus of claim 1, wherein the diesel engine drives an electrical transmission comprising:  
a generator generating a Direct Current (DC) power signal; and  
a DC traction motor coupled to an axle wheel set of the locomotive and responsive to the (DC) power signal for rotating the axle wheel set of the locomotive.
6. The apparatus of claim 1, wherein the diesel engine drives an electrical transmission comprising:

a generator generating a DC power signal;  
an inverter for receiving the DC power signal and inverting the received DC power signal into an AC power signal  
an AC traction motor coupled to an axle wheel set of the locomotive and responsive to the AC power signal for rotating the axle wheel set of the locomotive.

7. An apparatus for detecting operating parameters indicative of a surge event<sup>i/</sup> in a turbocharger of a locomotive engine system including a diesel engine and the turbocharger and controlling the operation of the engine system to reduce turbocharger surge, the apparatus comprising:

5 a sensor detecting an operating parameter of engine system indicative of a surge event and generating a sensor signal indicative of the detected operating parameter; and

an engine control system responsive to the sensor signal for controlling a speed of operation of the diesel engine;

10 wherein when the engine system experiences a surge event, the engine control system increases the speed of the diesel engine to reduce turbocharger surge.

8. The apparatus of claim 7, wherein the engine control system is responsive to the sensor signal to increase the speed of the diesel engine when the sensor signal indicates two surge events within a defined period of time.

9. The apparatus of claim 7, wherein the diesel engine operates at a plurality of discrete operating speeds and the engine control system is responsive to the sensor signal and increases the speed of the diesel engine from a first discrete speed at which the diesel engine is operating to a higher discrete speed when a change in the sensor  
5 signal over time indicates a surge event.

10. The apparatus of claim 7, wherein the engine control system increases the speed of the diesel engine an operating speed at which the diesel engine is operating to a higher speed for a predetermined period of time and thereafter decreases the speed of the diesel engine to the operating speed.

11. The apparatus of claim 10, wherein the predetermined period of time is one-hour.

12. The apparatus of claim 10, wherein the engine control system monitors surge events within the predetermined period of time and logs a report or generates a signal when a surge event occurs within the predetermined period of time.

13. The apparatus of claim 7, wherein said throttle has discrete operating positions 1 to 8 and wherein the engine control system increases the engine speed when the sensor signal indicates a surge event and when the throttle is located in one of notch positions 5, 6 or 7.

14. The apparatus of claim 7, wherein the sensor is a manifold air pressure (MAP) transducer associated with an intake manifold of the diesel engine and the sensor signal is a MAP signal representing the air pressure within the intake manifold of the diesel engine, and wherein the engine control system increases the speed of the diesel engine when the MAP signal indicates a decrease in the air pressure of equal to or greater than a predefined amount of pressure within the defined period of time.

15. The apparatus of claim 7, wherein the sensor is a turbocharger speed sensor that detects a rotational speed of the turbocharger and the sensor signal represents the rotational speed of the turbocharger and wherein the engine control system increases the speed of the diesel engine when the sensor signal indicates an increase in the turbocharger speed within a specified period of time.

16. The apparatus of claim 7, wherein the sensor is a pressure transducer associated with an air intake system of the turbocharger and the sensor signal represents an air pressure at the air intake system of the turbocharger, and wherein the engine control system increases the speed of the diesel engine when the sensor signal indicates an increase or decrease in the air pressure over time.

17. The apparatus of claim 7, wherein the sensor is a strain gauge or an accelerometer associated with a surface of an air intake system of the turbocharger

and the sensor signal represents a vibration or a deflection, respectively, of the surface of the air intake system, and wherein the control system increases the speed of the diesel engine when the sensor signal indicates an increase in the vibration within a  
5 preset period of time or indicates a deflection greater than a predetermined amount.

18. An apparatus comprising:

a locomotive driven by a locomotive engine system having a turbocharger and a diesel engine, the engine operable at a plurality of discrete speeds;

a sensor detecting an operating parameter of the turbocharger and/or the  
5 engine and generating a sensor signal representing the detected operating parameter;  
and

an engine control system for controlling the speed of the diesel engine at a discrete speed, each of which corresponds to a notch position of a throttle;

wherein the engine control system is responsive to the sensor signal and  
10 increases the speed of the diesel engine from a first discrete speed at which the diesel engine is operating to a higher discrete speed when a change in the sensor signal over time indicates a surge event of the turbocharger.

19. The apparatus of claim 18, wherein the engine control system increases the speed of the diesel engine when the sensor signal indicates two surge events within a defined period of time.

20. The apparatus of claim 18, wherein the diesel engine drives an electrical transmission comprising:

a generator generating a Direct Current (DC) power signal; and  
a DC traction motor coupled to an axle wheel set of the locomotive and  
responsive to the (DC) power signal for rotating the axle wheel set of the locomotive.

21. The apparatus of claim 18, wherein the diesel engine drives an electrical transmission comprising:

a generator generating a DC power signal;

an inverter for receiving the DC power signal and inverting the received DC power signal into an AC power signal

an AC traction motor coupled to an axle wheel set of the locomotive and responsive to the AC power signal for rotating the axle wheel set of the locomotive.

22. An apparatus for detecting and responding to a surge event in a turbocharger of a locomotive driven by a diesel engine, the apparatus comprising:

a sensor detecting an operating parameter of the turbocharger or the engine and generating a sensor signal representing the detected operating parameter; and

5 an engine control system for controlling a speed of the diesel engine corresponding to a position of a throttle;

wherein the engine control system is responsive to the sensor signal and increases the speed of the diesel engine when the sensor signal indicates two surge events within a defined period of time.

23. A locomotive propulsion system comprising a variable-speed diesel engine system having a combustion air intake manifold and an exhaust manifold, a fuel controller for supplying diesel fuel to the engine cylinders, a turbocharger connected to both of the exhaust and intake manifolds of the engine and having a turbine that is driven by the engine exhaust gases and that in turn drives a compressor for supplying pressurized air to the intake manifold, an engine speed sensor for sensing the speed of the engine, an electric power transmission system mechanically driven by the engine, and an excitation controller for controlling the power output of the transmission system; further comprising:

10 a sensor equipped to sense an operating parameter of the turbocharger or the engine and equipped to generate a sensor signal representing the sensed operating parameter; and

a controller adapted to receive the generated sensor signal for increasing the engine speed from a first discrete speed to another discrete speed for a predetermined period of time when a change in the sensor signal over time indicates a surge event.

24. The system of claim 23, wherein the operating parameter includes one or more of the parameters: manifold air pressure (MAP), manifold air temperature (MAT), fuel value, turbocharger speed, vibration parameter, deflection parameter, engine horsepower, wheel slip and mass air flow at the air intake manifold.

25. A method for detecting and controlling a surge event of a locomotive engine system including a turbocharger and a diesel engine operable at a plurality of discrete speeds, the method comprising:

- sensing an operating parameter of the engine system;
- 5 determining a change in the sensed operating parameter indicative of a surge event; and
- controlling an operational control of the engine system in response to the determined change.

26. The method of claim 25, wherein the operational control is the speed of the engine and wherein controlling is increasing the speed of the engine.

27. The method of claim 26, wherein increasing the speed of the engine comprises increasing the speed of the diesel engine from a first discrete speed to a second discrete speed for a predetermined period of time.

28. The method of claim 26, further comprising monitoring surge events after increasing the speed of the engine and logging a report or generating a signal indicative of a surge event when a surge event occurs within the predetermined period of time.

29. The method of claim 26, wherein controlling the speed of the engine is increasing the engine speed to the higher discrete speed for a predetermined period of time and thereafter decreasing the speed of the diesel engine to the first speed.

30. The method of claim 25, wherein determining the occurrence of a surge event further comprises determining the occurrence of three surge events within a defined period of time.

31. The method of claim 25, wherein sensing the operating parameter is sensing one or more of the parameters: manifold air pressure (MAP), manifold air temperature (MAT), fuel value, turbocharger speed, vibration parameter, deflection parameter, engine horsepower, wheel slip and mass air flow at the air intake manifold.

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32. The method of claim 25, wherein the operational control is the advance angle of the fuel injection and controlling is controlling the fuel injection advance angle.

33. The method of claim 25, wherein the operational control is a horsepower load on the engine system and controlling is decreasing a horsepower rating of an electrical transmission system.

34. A method for detecting and controlling a surge event of a diesel engine in a locomotive engine system including a turbocharger and a diesel engine operable at a plurality of discrete speeds of operation, the method comprising:

sensing an operating parameter of the engine system;

5 determining the occurrence of a surge event in the turbocharger wherein a change in the sensed operating parameter over time is indicative of a surge event;

controlling the speed of operation of the diesel engine to increase the speed of the engine from a first discrete speed to a second discrete speed for a predetermined period of time when the occurrence of a surge event is determined and thereafter

10 decreasing the speed of the diesel engine to the first speed;

monitoring for a further surge event after increasing the speed of the engine and within a predetermined period of time; and

generating a signal indicative of a surge event when a further surge event occurs during the predetermined period of time.

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